Issued December 14, 1912.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE WEST VIRGINIA GEOLOGICAL SURVEY;
I. C. WHITE, STATE GEOLOGIST.

SOIL SURVEY OF THE MORGANTOWN AREA, WEST VIRGINIA.

BY

CHARLES N. MOONEY, AND W. J. LATIMER

HUGH H. BENNETT, INSPECTOR IN CHARGE SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1911.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1912.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., May 16, 1912.

SIR: In continuation of the soil survey work in West Virginia, which is being carried on in cooperation with the State Geological Survey, one of the areas covered in the field season of 1911 was the Morgantown area, including the counties of Monongalia, Marion, and Taylor.

The accompanying map and manuscript report cover the work in this area, and I have the honor to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils for 1911, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

	Page.
Soil Survey of the Morgantown Area, West Virginia. By Charles N. Mooney and W. J. Latimer	5
Description of the area	5
Climate	8
Agriculture	9
Soils	15
Meigs clay loam	19
Dekalb silt loam	22
Dekalb silty clay loam	24
Dekalb stony loam	27
Westmoreland silty clay loam	29
Rough stony land	31
Elk silt loam	32
Holston silt loam	34
Tyler silt loam	35
Huntington silt loam	36
Moshannon silt loam	38
Summary	40

ILLUSTRATIONS.

PLATE.

	Page.
Plate I. Fig. 1.—A characteristic slope occupied by Dekalb silty clay loam and Westmoreland silty clay loam, southeast of Grafton, W. Va. Fig. 2.—Topography of the smoother portions, the valley areas, of the Dekalb silty clay loam and Westmoreland silty clay loam, southeast of Grafton, W. Va.	16

FIGURE.

Fig. 1. Sketch map showing areas surveyed in West Virginia	5

MAP.

Soil map, Morgantown sheet, West Virginia.

SOIL SURVEY OF THE MORGANTOWN AREA, WEST VIRGINIA.

By CHARLES N. MOONEY and W. J. LATIMER.

DESCRIPTION OF THE AREA.

The Morgantown area is situated in the north-central part of West Virginia and includes Monongalia, Marion, and Taylor Counties. The area is bounded on the north by Greene and Fayette Counties, Pa., on the east by Preston County, on the south by Barbour and Harrison Counties, and on the west by Harrison and Wetzel Counties.

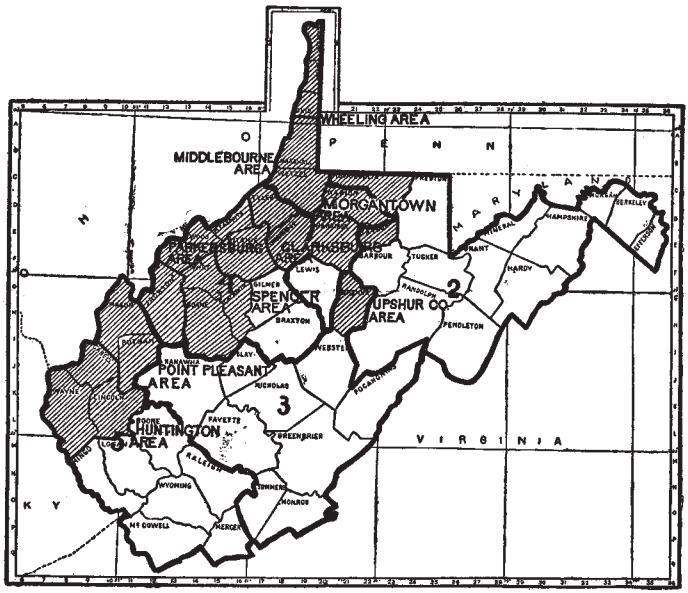

FIG. 1.—Sketch map showing areas surveyed in West Virginia.

The three counties together comprise an area of 560,000 acres, or 875 square miles.

The three counties included in this survey have the prevailing steeply broken topography characteristic of this portion of the Allegheny Plateau. The surface is deeply dissected by weathering and erosion extending through a long period of time. The plateau surface is broken occasionally by high knobs rising sharply above the general level of the surrounding uplands. The western section of the area reaches an elevation of 1,400 feet, rising imperceptibly to the east

and southeast to Chestnut Ridge, whose crest, forming the Monongalia and Preston County lines, has an elevation of 2,200 to 2,400 feet. In the extreme northeastern corner of Monongalia County one of the knobs attains an altitude of 2,683 feet, the highest point in the area. South of Cheat River this ridge, decreasing somewhat in elevation, spreads out and loses its mountainous character, merging into the general plateau levels. In part it is marked by long and rather steep slopes. Cheat River has cut a gorge through it, the walls rising from 1,100 to 1,200 feet above the river. Where the Monongahela leaves the area the elevation above sea level is slightly less than 800 feet.

The rocks of the region comprise a great variety of shales, sandstones, and limestones. These by their varying degrees of hardness and ease or resistance to the agencies of weathering and erosion give character to the local topography. Thus the shales and limestones which weather readily, give rise to smooth though often steep slopes while the sandstones are very resistant and give bolder relief. Where massive beds of the latter occur the outcrops frequently form precipitous cliffs, with rough, stony slopes below. The streams have cut their valleys into the plateau 300 to 600 feet below the general upland levels. Most of these valleys are narrow, with steep slopes and only narrow bottoms along the stream courses.

In the western part of the area, identified particularly with the Dunkard formation, the topography is for the most part broken, the ridges being narrow and the slopes steep and marked quite commonly with benches or shelves a few rods wide, due to the presence of massive sandstone beds. In Marion and Monongalia Counties, along the Monongahela River and in western and southern Taylor County, where the limestones and shales predominate, their weathering has resulted in a smoother topography, the hilltops being rounded and the slopes smooth, though often quite steep. Along the Monongahela and in places on the other larger streams high terraces of sedimentary materials are found. These were laid down in the valleys when the lower course of the Monongahela was blocked by ice during the glacial epoch.

The area drains into the Ohio River through the Monongahela and its tributaries. The latter stream flows in a general northeasterly direction through Marion and Monongalia Counties. At Fairmont the Monongahela proper is formed by the confluence of the West Fork with Tygart River. The West Fork of the Monongahela enters the area from Harrison and the counties to the south, while the Tygart River passes through Taylor County, having its source in the mountainous regions to the southeast. Another important tributary of the Monongahela is the Cheat River, which rises in the mountains east of Tygart River, enters from Preston County into northeastern Monon-

galia County, and empties into the Monongahela at Point Marion, in Pennsylvania, a short distance over the West Virginia line.

There are numerous large creeks emptying into these larger streams, which in turn are supplied by smaller streams and runs, making an intricate network of drainage courses. The rivers and larger creeks are perennial in flow, but the smaller streams are usually dry during the summer season. The broken topography admits of rapid surface drainage and with heavy rains the streams become swollen torrents, but their waters soon subside after the rains cease. The majority of the streams flow rapidly over rocky beds, with occasional small cascades or falls in their upper reaches. The larger streams have meandering courses. The Monongahela is made navigable by a system of dams and locks from the Ohio River at Pittsburgh as far up as Fairmont.

The earliest attempt at settlement in the area was made at the present site of Morgantown, in 1758, but it was not until two years later that a permanent settlement was established. The new settlers located along the Monongahela River, taking up the valley lands first and later pushing inland. Settlement was slow until after the Revolutionary War, when numbers of immigrants from Maryland and Virginia of Scotch-Irish descent located in the area, followed later by "Pennsylvania Dutch."

Monongalia is the oldest of the counties in this section of the State and originally comprised a large area of territory now included in surrounding counties. Marion County was formed in 1842 and Taylor County in 1844.

The present rural population is composed largely of the descendants of the early settlers. Within the last 20 years there has been a marked immigration of foreigners, mainly Slavs and Italians, who supply the greater part of the labor in the coal mines and the unskilled labor employed by the factories and railroads. The population in the last two decades has increased rapidly, Marion County in 1910 having a population of 42,794, Monongalia 24,334, and Taylor 16,554, a total for the area of 83,682.

There are a number of important manufacturing towns and cities in the area. Fairmont, the county seat of Marion County, is the largest city in the area, having a population of 9,711 in 1910. Mannington is another important city in Marion County, with a population of 2,672. Morgantown, the county seat of Monongalia, has 9,150 inhabitants, and Grafton, the county seat of Taylor County, and an important railroad center, has a population of 7,563. A numerous population, mostly foreigners, employed at the different coal mines, is found along the Monongahela River. Small towns and villages are scattered through the outlying districts.

Telephone lines and rural free delivery of mails reach all parts of the area, and it has exceptionally good transportation facilities, being traversed by a number of railroads belonging, with one exception, to the Baltimore & Ohio system. A local packet and freight service is also in operation on the Monongahela River. The development of the transportation facilities has been brought about by the valuable beds of coal that are being mined within the area.

The wagon roads are numerous. Some of them are the turnpikes of the early days, when the only means of transportation was by wagon.

The roads usually follow the valleys and when they cross ridges do so through the low gaps, the more important roads being located with reference to easy grades. The less important roads often climb steep hills and follow the tops of the narrow ridges.

CLIMATE.

The following table, compiled from records of the Weather Bureau station at Morgantown, shows the mean monthly, seasonal, and annual temperature and precipitation, maximum and minimum temperature and precipitation, the total precipitation for the wettest and driest years and the normal snowfall:

Normal monthly, seasonal, and annual temperature and precipitation at Morgantown.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	°F.	°F.	°F.	Inches.	Inches.	Inches.	Inches.
December	34	69	4	2.5	1.5	0.7	6.8
January	31	69	− 1	3.0	1.6	5.8	7.0
February	30	80	−25	3.0	3.0	1.7	5.6
Winter	32			8.5	6.1	8.2	19.4
March	43	90	− 4	3.9	3.6	6.2	6.2
April	51	93	8	3.6	1.5	4.9	2.8
May	63	94	28	3.7	2.1	4.8	0.0
Spring	52			11.2	7.2	15.9	9.0
June	69	99	37	4.8	5.4	5.2	0.0
July	75	101	44	5.1	6.9	4.0	0.0
August	73	105	44	3.6	4.3	7.9	0.0
Summer	72			13.5	16.6	17.1	0.0
September	68	102	33	2.1	0.5	2.8	0.0
October	55	94	15	2.4	3.9	5.6	0.0
November	44	80	9	3.3	5.1	2.7	1.0
Fall	56			7.8	9.5	11.1	1.0
Year	53	105	−25	41.0	39.4	52.3	29.4

These figures represent with fair accuracy the average conditions obtaining in the area. The mean annual temperature is 53° F. The summers are pleasant, though in the valleys the temperature is often rather high, though rarely exceeding 100° F. An absolute maximum of 105° F. has been recorded in August and of 102° F. in September. The winters are moderately cold, the seasonal mean being 32°. Sharp cold spells occur, but are of comparatively short duration. The lowest temperature recorded is −25° F. The average date of occurrence of last killing frost in the spring falls in the latter part of April and of the first in the fall in the first week of October. The growing season is thus of sufficient length for all crops grown in this general region to mature.

The mean annual rainfall amounts to 41 inches and the precipitation does not vary much from year to year. It is fairly well distributed, though in later summer and fall droughts occur and in that case it is not infrequently difficult for fall-sown grain and grass to make satisfactory growth before the setting in of cold weather. A part of the precipitation is in the form of snow, the average depth amounting to 29.4 inches, or if reduced to rain somewhat more than 2 inches.

The climate is healthful and numerous summer tourists spend the warm season in the mountainous section of the northeastern part of the area.

AGRICULTURE.

The agricultural development of this section was slow, barely keeping pace with the increase in population, as outside markets were remote and no satisfactory means of transportation existed. Conditions were improved somewhat by the construction of the State road about 1800, which passed through this section, bringing increasing numbers of settlers into the area and making it possible to get more of the products of the farm out by wagon. The construction of other turnpikes followed, and considerable trade passed over these roads.

During this period agricultural production was gradually increasing and the clearing of new land constantly carried on. Corn, wheat, rye, oats, buckwheat, and potatoes were the staple crops, and by 1840 their output had reached considerable proportions. These crops, with exception of rye, have continued the staple crops of the area to the present time. Since 1880 the acreage devoted to rye has decreased rapidly, and only a few acres are now grown in the three counties. The production of corn has increased, and so in general has the production of wheat. The production of buckwheat reached a maximum in Monongalia County in 1859. It is still grown to con-

siderable extent, but the acreage varies greatly from year to year. The production of potatoes has from the first shown a steady increase.

Stock raising dates from the early days of settlement, when cattle and sheep raising was an important industry. The section is well adapted to grazing, bluegrass being indigenous to at least a part of the soils. Sheep were at first brought in to furnish wool for clothing, but as the climate and grazing were favorable this branch of stock raising became profitable on a larger scale, especially in the western part of the area. The industry reached its highest mark in 1880, and since that time has gradually declined. The fattening of lambs, sheep, and beef cattle has taken the place of wool growing. The limestone land (Westmoreland silty clay loam) and the soils of the Permo-Carboniferous or Dunkard formation (Meigs clay loam) are especially suited to grasses, seeding to bluegrass naturally. The former was largely devoted to cattle grazing, while the latter especially was well suited to sheep.

The tree fruits were introduced shortly after settlement, and the apple especially has thrived, but its production has never exceeded the needs of home consumption.

The development of the oil and gas resources soon after 1890, especially in Monongalia and Marion Counties, has taken much attention from the farms. Much labor has turned to the new fields, and landowners have necessarily curtailed their operations and now depend more upon the rentals and royalties they receive, which in most cases far exceed the profits of the farm. Under these conditions agricultural production has come practically to a standstill, and more land is in grass, although the number of cattle grazed has not increased, for while there is plenty of pasture the number of stock kept is dependent upon the grain and hay that can be produced to feed them through the winter months.

The agriculture of the area is of a mixed type. It is based upon stock grazing, with general farming to produce the crops required to carry the cattle over the winter. The finished beeves form the chief source of income. The average farm, as a rule, does not produce sufficient to meet its requirements, especially of grain, and very little grain or hay is sold at the local markets. Larger quantities are shipped into the area. The production of these staple crops is confined principally to the valleys. The steep hillsides make up most of the grazing lands.

Corn is the main crop and good yields are made on the bottomland soils. Some of the better upland slopes are also used for this crop. The acreage in this crop is larger than that devoted to any other crop except hay. For the three counties the yield of corn per acre is about 30 bushels. Wheat leads the small grains, the acreage

devoted to it being quite constant, and averaging about three-fourths the acreage in corn. According to the census the average yield is about 10 bushels per acre. The oat crop is also important. The average yield is low, however, ranging from 15 to 20 bushels per acre.

The acreage in buckwheat has varied considerably in the past, but is now increasing, as the demand for the flour has made it a profitable crop. It is practically restricted to the eastern part of the area, where the altitude and the soils are better suited to its production than elsewhere. This crop usually follows wheat or oats, being planted in July. Two crops of buckwheat, however, can be taken from the same ground in a single season, and this is done by a few farmers. The yields range from 10 to 35 bushels per acre.

The total production of potatoes is considerable, but the crop is grown mainly in small patches to supply the family needs. In the eastern part of the area it is a more important crop, being grown for the local markets. The supply is not equal to the demand, as potatoes are shipped into the area in large quantities. There is a large area of land that could be devoted to this crop. The Elk silt loam, in the Monongahela Valley will be found particularly well adapted for potato production. At least enough potatoes should be produced to meet the local demands.

The acreage in grass and other forage crops cut for hay is about the same as that devoted to all cultivated crops combined. Timothy, redtop, and clover are the principal hay crops. Clover is usually sown with the other grasses. Redtop is gaining in favor, as it gives good stands. It does not cut so heavy a crop as timothy or orchard grass. On the bottoms and lower slopes, where good moisture conditions prevail, orchard grass is sometimes sown and does well, making a heavy yield of hay. The average yield of hay over the three counties is a little less than 1 ton to the acre. On the bottoms and the more or less calcareous soils the yield is higher, but the average is lowered by the thinner and inferior soils. The millets are gaining in favor and patches and fields in some sections are quite numerous. The yield is heavy.

Cowpeas are grown to some extent and should receive more attention, as they are a valuable forage crop and a soil improver as well. A few small patches of alfalfa have been tried with indifferent success. On the calcareous soil, with proper treatment, this crop should succeed.

Of the improved land in farms in Monongalia and Taylor Counties about one-fourth is devoted to cultivated crops and grasses cut for hay, while in Marion County the proportion is larger, being about one-third, there being less rough land in this county than in the others. The remaining improved land is probably in more or less permanent pasture.

Some dairying is done in the vicinity of the larger towns, but the supply of milk is barely sufficient to meet the local demands. The purebred Jerseys and Holsteins, the former introduced as early as 1878 and the latter within comparatively recent years, with some good grades constitute the dairy stock.

The high prices for poultry products during the last few years have given a stimulus to this industry and poultry raising is increasing in importance both for egg and meat production.

Apple orchards are said to have existed as early as 1779. Fruit growing in the area, however, has not been developed on a commercial scale. A few trees are to be found on most farms, but only to supply the family. These are not given attention except in a few instances. The few small orchards that are given good cultural treatment and sprayed have proven profitable to the growers. There is a wide range in varieties suited to this section, including the summer, fall, and winter apples. There are plenty of good orchard sites to be found in the area.

Blackberries, raspberries, and strawberries do well in this section, but their growth is limited to small home patches. A few patches of berries produced for market have paid good profits and the small fruits should receive more attention. The high terraces along the Monongahela would be especially adapted to their cultivation.

Vegetables are limited practically to the home gardens. There is an excellent opportunity to develop trucking in this section, as there is a strong and growing demand for vegetables, which are now shipped in instead of being produced locally. From the first of July until the frost comes growers could meet all outside competition if an effort were made to supply the local markets. The Elk silt loam, a terrace soil, is well suited for producing the truck crops, of which a wide range could be grown. The heavier crops would doubtless prove more profitable because of the local demand for this class of produce.

As noted already the development of the oil and gas resources of the area has diverted interest from farming to a large extent. This is due in part to the labor going into those fields, where high wages are paid. The development of coal mining has had practically no effect upon the supply of farm labor, as the labor in the mines is nearly all performed by foreigners unskilled in farm work. The output of the farms could be increased, however, with the labor still available, should the owners exert themselves in that direction. Where the oil and gas fields are giving out or tests have not disclosed any new deposits the owners are being forced to return to their farming and are taking up the work with renewed interest.

The upland farms are much more difficult to manage than the valley farms, as more hand labor is required. Though improved

farm implements are employed wherever possible, there is much land where machinery can not be used. Improved machinery of all kinds is found on the valley farms. On the hillsides contour cultivation is necessary to prevent washing. Great care is necessary in farming slopes, as they wash easily. In the early days very little care was taken to protect the land, as there was plenty of new lands available, so that fields were cropped continously until "worn out" and then abandoned and soon taken by grass. While some crop their fields continuously, the practice is not favored now. To keep the fields from washing the slopes are kept in grass as much as possible. The roots in newly cleared land and sod will hold the soil for one or two cultivated crops and then it must be seeded to grass. Soil erosion is also lessened by having different crops on the slopes. Strips of cultivated ground are alternated with strips in sod. There is thus a kind of crop rotation followed on the upland slopes, but none is strictly adhered to, the period in grass being indefinite. The usual practice is sod land plowed and planted to corn for one season and rarely for two, followed by oats, then by wheat, in which timothy and redtop are sown, and in the spring usually clover. The grass is cut for hay until the yields become unprofitable and is then pastured for an indefinite period, usually as long as the grass holds well. Potatoes in the eastern part of the area find a place as a cultivated crop in the rotation with corn. Buckwheat in the eastern part is used as a crop following oats or as a catch crop for areas where some other crop has failed to germinate properly. Shorter crop rotations where the land is easily tilled are advisable and variations in the rotation can be made to suit the different conditions.

On the bottom lands no rotation is practiced, corn being practically the only cultivated crop. Yields are maintained by applications of manure. In the crop rotations on all the soils of the area a legume should always find a place.

The practice of cropping, especially in the early days, was destructive, little thought being given to maintaining the soil fertility. As crop yields later decreased fertilization was resorted to. Barnyard manure was always saved and used, and liming was a common practice. As early as 1855 guano was used with good results, and this was soon followed by commercial fertilizers, consisting of ammoniated phosphates, the phosphate carrier being phosphate rock or bone meal, the latter preferred. An increase in yields of nearly 33 per cent was reported on the depreciated lands. Barnyard manure followed by lime was considered the cheaper treatment and produced the most satisfactory results.

With the development of the mineral resources and decline of agriculture the use of fertilizers, particularly the commercial brands, was discontinued and even liming was not so common. At the

present time and on most of the soils of the area, except those of the western section, or the soils derived from the Permian formation (Meigs clay loam) the use of commercial fertilizers has once more become general. On the latter soils it is said the improvement does not warrant the additional expense. The use of fertilizers on the limestone land (Westmoreland silty clay loam) is not common, but on the different soils of the Dekalb series some form of commercial fertilizer is used almost without exception. These Dekalb soils are thin and fertilization is necessary to secure anything like a fair yield. The fertilizer practice, however, has not reached any settled basis, the farmers using different kinds largely upon the advice of dealers. As a result accurate information on this question is not at present available. For corn, wheat, and oats a fertilizer having a formula of 8–2–2 is generally used.

Potatoes are usually fertilized with an 8–4–2 mixture. The proportion of potash should be higher than this in order to get the best results. The same mixture is also used by some for garden vegetables. For grass a fertilizer high in phosphoric acid, with small quantities of potash, is applied by some farmers. Ground bone has from the first been popular for the cereals and grasses. There is considerable variation in proportions of the several salts in the mixtures used for these crops, generally in the quantity of phosphoric acid and to less extent in potash. Very often the fertilizer mixture is made of 8 per cent phosphoric acid, 2 per cent nitrogen, and 2 per cent potash. Fertilizers are used on all crops except on meadows and permanent pastures, the grass getting an application at the time of sowing with small grains. The quantity of fertilizer used in the general practice of the region is small, ranging from 100 to 200 pounds to the acre. Where pastures can not be conveniently broken they may be improved by applications of finely ground rock phosphate or floats.

Experiments conducted by the State experiment station show that phosphates are the controlling factor in the treatment of soils of this region. Potash is necessary in potato production.

The experiment station after a series of trials during a number of years finds the most satisfactory results where the soils had been limed and barnyard manure applied annually. There is some liming done at present, especially where suitable limestone is found near at hand and can be burned on the place. All the soils, according to the farmers, respond readily to the use of lime. It should be used, however, in connection with applications of organic manures, either barnyard manure or a green manuring crop, preferably a legume. The soils are generally deficient in organic matter and any system of soil management should be planned to supply it in some form. Stable manure should be carefully protected from leaching, and,

where this is not possible, it should be spread on the land as rapidly as it is made.

The farms vary considerably in size, from holdings of a few acres to several hundred acres, the average for the three counties, as shown by the last census, ranging between 90 and 100 acres. There has been little change in size for some decades. Renting of farms is not a common practice, the owners either tilling the farms themselves or superintending the work. The census of 1900 shows that of the total number of farms in the area between 80 and 82 per cent are operated directly by the owners themselves. When rented it is usually on a share basis, but the terms of leases vary greatly. A number of farms are operated by hired managers.

Labor is scarce but efficient and commands good wages. Under the present conditions little farm labor is required, except at special seasons, such as harvesting time.

Farm values have increased considerably in the last few years, the surface rights alone bringing now as much as they did formerly when oil, gas, and coal were included. The sale of the oil or gas rights and the rentals and royalties therefrom and the sale of the workable seams of coal have put most farmers in fairly good circumstances. While not working the farms to best advantage, they have improved them by the erection of good dwellings and outbuildings, and consequently there is often an appearance of prosperity which is not in keeping with the character of the land. The value of farm lands ranges from $5 an acre for the poorer and more remote farms to $100 an acre for farms located on better soils near towns. There is very little land on the market.

SOILS.

The soils found in the area fall into two main groups—residual soils of the upland and transported soils of the stream bottoms and terraces. Exclusive of areas of Rough stony land 10 distinct types of soil were mapped.

The upland types are the most extensive, covering fully 90 per cent of the area surveyed. They are derived from the underlying rocks by the ordinary processes of weathering. The rock formations are of sedimentary origin and of Carboniferous age. They comprise a great variety of interbedded shales, sandstones, and limestones, including some coal seams. The materials forming these rocks having been deposited by water were laid down horizontally, but during a later period they were given a gentle tilt westward in the area as a whole, and at the same time were bent into a number of low anticlines and shallow synclines. The only one of these strong enough to have any significance in soil formation was the one that formed Chestnut Ridge. When formed it was a ridge and because of this it

has been more vigorously attacked by erosion than has the plateau surface on either side of it. It has not yet been reduced to the general level of the surrounding country, but deeper lying rocks have been uncovered along it than elsewhere. These have weathered into soils differing from those found over the plateau in general. The general westward dip of the beds has caused the occurrence on the surface of the younger beds in the western part of the area and of successively older beds eastward.

From the lowest rock exposed in the area—the beds uncovered where the Cheat River Valley cuts Chestnut Ridge—to the highest bed of rock exposed there is a total thickness of about 3,000 feet. This section is made up of five formations, named in the order of their age, from the youngest to the oldest, the Dunkard, Monongahela, Conemaugh, Allegheny, and Pottsville. The Pocono and Pottsville sandstones and the Greenbrier limestone are resistant rocks and give rise to areas of Rough stony land of no value except for the forest growth. Thus only the Dunkard, Monongahela, Conemaugh, and Allegheny formations form soils of agricultural value. The soils thus formed are of a silty texture on the surface, with clay loam, silty clay loam, or silty clay subsoils.

These soils are all very similar in texture, but differ somewhat in color and especially in agricultural value. These differences depend mainly upon the character of rocks from which the soils were derived and to some extent upon their general topography.

The Dunkard formation occurs in the western half of Marion and Monongalia Counties. It is composed of interbedded gray and brown shales and sandstones, with thin beds of red shales. The weathering of these rocks gives rise to the Meigs clay loam, which, owing to the different varieties of rocks from which it is derived, varies in color from grayish to light brown, with strips and patches of Indian red. In the eastern part of the area the Dunkard formation has been eroded away, exposing the next underlying formation, the Monongahela. Some Dunkard outliers are found capping the tops of ridges and knobs, but the rock is so much like the upper 100 feet of the Monongahela rocks that the resulting soils are the same for these parts of both formations. These soils have a decidedly yellow subsoil and are designated Dekalb. Shale strata predominate in this part of the formation and give rise to a smoother and more rounded topography than that of the Meigs soil region, and produce also only one type of soil, the silty clay loam.

The rest of the Monongahela formation and part of the Conemaugh in the area, as in the counties immediately south of it, is composed in part of a number of limestone beds and calcareous shales interbedded with gray shales and to a less extent with sandstones. The weathering of these rocks has resulted in a relatively smooth topog-

FIG. 1.—A CHARACTERISTIC SLOPE OCCUPIED BY DEKALB SILTY CLAY LOAM AND WESTMORELAND SILTY CLAY LOAM, SOUTHEAST OF GRAFTON, W. VA.

FIG. 2.—TOPOGRAPHY OF THE SMOOTHER PORTIONS, THE VALLEY AREAS, OF THE DEKALB SILTY CLAY LOAM AND WESTMORELAND SILTY CLAY LOAM, SOUTHEAST OF GRAFTON, W. VA.

raphy. The belt is quite noticeable, aside from its topography, by the generally better growth of grass and the more thrifty appearance of the farms.

These rocks have given rise to gray soils, with yellow subsoils, known in soil classifications of the region as the Westmoreland soils. They are called locally "limestone lands." In this area there is only one type of the series and it is found along the Monongahela River in Marion and Monongalia Counties and in western and southwestern Taylor County. While a certain part of the Monongahela and Conemaugh formations may be expected to carry limestones, there are exceptions. From Fairmont north on the east side of the Monongahela River the limestones are in part or wholly lacking. East of the Monongahela, where the Pittsburgh coal is rising and is in the tops of the hills, it is capped by massive sandstone, which gives rise to the Dekalb silt loam. Elsewhere where the coal vein is lower limestone is found to 280 feet above the Pittsburgh coal or the top of the Uniontown limestone. This latter is the most constant factor of the type. The limestones are lacking or unimportant as affecting the soils below the Pittsburgh coal formation. Usually, however, the limestone land is found to the horizon of the Clarksburg limestone, 165 feet below the Pittsburgh coal. In southern Marion and in western and southwestern Taylor Counties the limestone strata are sufficient to give character to the land to a level 350 feet below the Pittsburgh coal.

The formations below the limestone-bearing strata in this area consist of shales and sandstones, the sandstones as a whole predominationg. These give rise to Dekalb soils and on account of the abundance of resistant sandstone present Rough stony land occurs in large areas, though the shales as elsewhere produce fine-grained soils.

As a whole the upland soils in this area exhibit a strikingly close relation to the character of the rock on which they lie. The rock beds dip gently westward. The general upland surface slopes gently westward also, but not so rapidly as the dip of the rock beds. The surface plane therefore cuts the rock planes in such a way that the youngest beds occur in the western part of the county. The underlying formations down to the Pocono sandstone outcrop in successive north-south belts east of this, the most easterly belt being the Pocono belt in Chestnut Ridge.

The highest formation contains a great deal of red shale interbedded with sandstones and gray shales, resulting in an intimate association of red and gray or yellow soils, which are grouped together as Meigs.

East of this lies a belt of rocks free from red shales. They weather into gray soils with yellow subsoils, the Dekalb. East of this belt

lies a belt of alternating shales, sandstones, and thin limestones. These weather into soils indistinguishable in appearance from Dekalb soils, but more productive, the Westmoreland soils. The next belt eastward is free from red shales and limestones and produces Dekalb soils, but the abundance of massive resistant sandstones produce a great deal of stony soil.

The transported soils consist of first bottoms along streams and the high terraces in places bordering the Monongahela and other large streams. The terrace material was deposited when the water stood at higher levels. The original flat surface of these has been more or less dissected by erosion since the stream waters dropped to lower levels. The material of the terraces along the Monongahela includes wash from soils derived from limestone, calcareous shales, shales, and sandstones. Such areas have been classed as Elk silt loam. The Holston silt loam is very similar to the Elk in color and texture, but it includes less limestone and calcareous shale material, for the soils of the drainage basins of its streams are primarily derived from shale and sandstone. It is found most extensively along Dunkard Creek and in a few places along some of the other larger creeks and the rivers. It is a less productive soil than the Elk silt loam.

The Tyler silt loam is closely associated with the Holston, and, in fact, represents Holston material that has existed under poor drainage conditions. Its development in the Morgantown area is small.

Two first-bottom types have been developed in the area. The more extensive is the Huntington silt loam, formed along streams depositing the wash from limestone, sandstone, and shale soils. The Moshannon silt loam differs in color from the Huntington, the sediments coming from the red materials occurring in the Meigs clay loam having imparted a reddish or reddish-brown color to the alluvial type. Both of these types are strong, productive soils, and especially adapted to corn and grass. While nowhere do they occur in large bodies, their extent is considerable in the aggregate and they are of great importance to the agriculture of this section.

The following table gives the names and areas of the various soil types mapped:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Dekalb silty clay loam	204,480	36.5	Huntington silt loam	12,288	2.2
Meigs clay loam	170,368	30.4	Moshannon silt loam	7,296	1.3
Westmoreland silty clay loam	64,000	11.4	Holston silt loam	3,200	.6
Rough stony land	46,976	8.4	Tyler silt loam	448	.1
Dekalb stony loam	20,224	3.6			
Dekalb silt loam	16,768	3.0	Total	560,000	
Elk silt loam	13,952	2.5			

MEIGS CLAY LOAM.

The Meigs clay loam comprises undifferentiated Dekalb and Upshur soils, with some areas of an intermediate type—a Dekalb-Upshur soil. Separation of the several types was impracticable owing to their intricate association. A considerable proportion of the soil in this area is not altogether typical of the soil as mapped farther south in the State, where the distribution of the Dekalb, the Upshur, and the intermediate soil is more nearly equal. There are many places in the present area where the Dekalb silt loam and silty clay loam predominate over both the Upshur and the intermediate soil; in fact, it was difficult at times to decide whether to map the soil as Meigs clay loam or as Dekalb silt loam or silty clay loam including some patches of Upshur not differentiated on account of their small extent.

The Dekalb material is prevailingly a silt loam to silty clay loam, about 4 to 8 inches deep, the immediate surface being generally decidedly silty. The color is a light brown to grayish brown, grading with depth into a light yellow. The subsoil ranges from a brownish-yellow, moderately compact silt loam to silty clay loam, grading frequently into silty clay at about 15 to 20 inches, the texture persisting usually to the underlying parent rocks. On steep slopes where erosion is active the clay subsoil is often nearer the surface and in places is even exposed.

The frequent patches of Upshur soil have the characteristic Indian-red color of the series. They occur on the slopes, crests of ridges, and tops of hills over the red shales from which the soil is derived. The Upshur soil consists largely of Indian-red silty clay loam or clay, underlain by stiff, plastic Indian-red clay, having usually a greasy feel. These areas would be classed mainly as the Upshur clay type if they had been large enough or of sufficiently regular shape to map.

Spots are found on slopes where the wash or soil creep from the Dekalb soils above has covered the red clay, thus giving rise to a grayish or light-brown soil with a red clay subsoil—a Dekalb-Upshur type. Along boundaries between the yellow and red or where the shale beds are not thick and prominent the color is reddish yellow or the yellow is mottled with red. In this area the Meigs clay loam is not so typical as it is in the counties mapped to the south because the red materials are not so abundant, although there is still enough of the characteristics of the Meigs clay loam to give the land this classification.

The depth of the soil and subsoil varies considerably, depending upon the position of the areas. On the steep slopes erosion has prevented the accumulation of much soil material over the rock, the strata being exposed in places, or at least very near the surface. Usually the depth to the bedrock is 20 inches or more, and

frequently it is not encountered within several feet of the surface. Throughout the soil mass and upon the surface occur more or less decomposed fragments of shale and sandstone, though rarely in sufficient quantity to interfere with cultivation.

The Meigs clay loam is one of the extensive soil types of the area. It occurs in almost uninterrupted bodies in western Marion and Monongalia Counties. East of this unbroken belt small areas are scattered through the other soil types in central Marion and Monongalia and in western Taylor Counties. These areas cover the sharp crests of ridges and the hilltops.

The type is characterized by broken to hilly topography, the surface as a whole being rougher than any other soil type except the Rough stony land. The tops of the ridges are generally narrow and irregular, and the slopes as a rule descend steeply to narrow V-shaped valleys. The elevation of the ridge tops ranges from 300 to 500 feet above the valley floors. A feature of the hillsides is the presence of narrow benches or terraces, caused by massive sandstone beds that have resisted weathering and prevented the formation of uniform slopes. On these benches the soil is generally deeper, more loamy and productive than on the slopes and tops. Over the greater part of the type the slopes are so steep as to make their cultivation difficult. The run-off is rapid, and where not protected by a covering of sod or other vegetation the soil material is washed away, forming erosion gullies. There is little opportunity for the storage of moisture and the type is more or less droughty, crops suffering in ordinary dry spells, except in favored locations. Small springs or seepage places occur in the ravines, but these fail in times of drought, and the small runs fed by them usually go entirely dry also. Even the larger streams have very little flow or cease entirely except for the seepage waters passing from pool to pool through their gravels.

The Meigs clay loam is of residual origin, and derived from a variety of sedimentary rocks of Upper-Carboniferous age. The Dunkard formation gives rise to most of this type, although the upper Monongahela formation enters to some extent, especially in the eastern section of the area. These formations consist of a series of interbedded shales, sandstones, and some thin or shaly limestone, coal seams, and accompanying fire clays. Some of the sandstones are fine and some coarse, some massive, and some thin bedded and shaly. The shales also vary from thin to thick bedded and from argillaceous to sandy. Gray shales and sandstones and the red shales give rise to most of the material forming this type.

Although the Meigs clay loam is steeply broken, the greater part of it is cleared and has been under cultivation for some time. The object in clearing this land has been to furnish pasturage, as it is

fairly good for grasses. Bluegrass does well on most of it, although rather short lived, except upon phases of soil particularly adapted to its growth. North and east slopes are much the better pasture land and are also better for the cultivated crops. Southern and western slopes, through longer exposure to the sun's rays, dry out more quickly. In changing this land from its natural forested condition to pasture, care must be taken to prevent erosion. When newly cleared the soil is full of roots, which ordinarily hold it sufficiently for a few years, or until the grasses form a protective sod, but it will not do to grow too many intertilled crops before seeding down.

Corn is the first crop grown and in the early days was planted until the yield had decreased, when small grains, with which the grasses were seeded, were sown. Bluegrass holds for a time and then the native wild grasses and broom sedge gradually take possession of the land. To reestablish bluegrass it is necessary to break the fields again, cultivate one or two crops, and then reseed. Commonly the bluegrass comes in naturally following the cultivated grasses that are cut for hay. The red soils occurring on the slopes are best suited to bluegrass, holding sod about as well as the limestone lands. In fact, these red shale beds are more or less calcareous. Very little care is given the pastures beyond the occasional cutting of the weeds and other growths, yet much of the land after long periods, in some cases of more than 50 years, is still producing good pasture, with no sign of deterioration.

Where the pasture sods do not hold well, their life should be prolonged by giving them top dressings of stable manure, or where this is not available applications of lime and phosphoric acid. Where they can be had cheaply, ground limestone and phosphatic rock (floats) may be employed to advantage.

Timothy, redtop, and clover are grown for hay and give good yields. The fields are then pastured, bluegrass coming in as the other grasses die out. Very few of the steeper hillsides are cultivated, but corn does well upon the slopes, especially on new or sod land. The yield ranges from 20 to 75 bushels an acre, without commercial fertilizers, and averages about 35 bushels. The higher yields are obtained on the more level areas and the lower slopes. It is the practice now to take not more than two crops of corn before seeding down to small grains and grass. Wheat and oats also give fair yields.

Fertilizers are not used on this soil to any extent. They were tried some years ago, with unsatisfactory results, and their use was discontinued. There is a tendency now, however, to revert to their use. There is apparently no reason why this soil should not respond to the use of lime and the phosphatic fertilizers.

Parts of the type will produce fruit, apples and peaches doing well. The upper slopes, in the covelike areas with north and east exposures, where the soil is more loamy and better moisture conditions prevail, are good locations for orchards.

The forest growth on the Meigs clay loam consists of oak, chestnut, maple, hickory, and poplar. The poplar was found most abundant on the northern and eastern exposures and gave to these locations the name "poplar land," while the south and west slopes are classed locally as "white oak land." The latter is not so highly valued as the former.

Farm lands of the Meigs clay loam range in price from $10 to $75 an acre, with the oil, gas, and coal rights reserved. The general average is about $35 an acre. The price has advanced somewhat in recent years.

DEKALB SILT LOAM.

The surface soil of the Dekalb silt loam consists of a grayish-brown, smooth, friable to heavy silt loam, becoming pale-yellow in color below the first 3 or 4 inches. The subsoil, encountered at an average depth of 8 inches, consists of a yellow silt loam, usually grading into a silty clay loam and occasionally into a silty clay, somewhat plastic in structure. Where the underlying sandstone beds approach the surface the subsoil, in its upper section, differs very little in texture from the surface soil, but becomes more sandy as the bedrock is approached. The sand particles range from fine to very fine and give a gritty to sandy feel. Where typically developed the type is close and compact in structure, while in the sandy subsoil phase it is more open and friable.

As a rule the type is free from stone fragments, except where it grades into the stony types, such as are developed on the upper or lower slopes, in which case some shale and slabby pieces of sandstone are encountered. The depth of soil is usually more than 3 feet, but occasionally the underlying rock comes within 2 feet of the surface. The average depth is probably between 6 and 10 feet.

The Dekalb silt loam is found in small, irregular bodies scattered throughout areas of the other upland soils. The total area is relatively small. The areas occur on flat tops of hills and ridges and on flat benches or shelves (not stream terraces) on slopes, and have a flat to gently undulating surface. In places this soil extends down gentle slopes, but nowhere does it occur on steep slopes.

The type owes its position to the presence of massive beds of resistant sandstone that have withstood weathering. The soil material was derived from the overlying grayish shales and fine-grained sandstone, and probably also to some extent from the underlying massive sandstone beds.

The high position of the Dekalb silt loam insures good drainage, although the more level areas may need some ditches or tile drains to put them in the best possible condition.

The moisture-holding power of the type is low and as a whole it is inclined to be droughty, especially in areas where the bedrock approaches the surface. In only moderately dry spells crops often suffer from lack of moisture.

All of the type is cleared and under cultivation, being considered a desirable soil because of its smooth and even surface. Most of this land has been under cultivation for a long time and cropped rather exhaustively. It is only a moderately productive soil. The grasses do only fairly well and only light yields of hay are secured under ordinary conditions. Bluegrass does not thrive sufficiently to encourage the use of this soil for grazing. Small grains, with fertilizers, make good yields. Buckwheat does comparatively well and also Irish potatoes, the latter yielding from 50 to 100 bushels. These yields could be increased readily with better methods of culture. Corn gives only moderate crops.

This soil is deficient in organic matter and a system of soil management to supply this important soil constituent should be followed. Stable manure is one of the best fertilizers, adding plant food, supplying organic matter, and improving the tilth and moisture-holding capacity of the soil. The State Experiment Station has found by experiments conducted on this soil that increases in all crops were made with the use of manure, and that better results were secured with manure than with any other fertilizer. Where stable manure is not available green manuring crops, especially the legumes, such as clover and cowpeas, should be employed.

This soil is favorably located in most cases for orchard fruits, particularly apples.

The original native growth consisted of oak and chestnut.

The areas of this soil are so small that rarely is a farm composed entirely of this one type, and while it is not as strong as the soils on the slopes, farms which include some of this type are considered very desirable, particularly for the production of garden vegetables, potatoes, and buckwheat. The value of the land varies according to location and accessibility. Ordinarily prices range from $10 to $50 an acre.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Dekalb silt loam:

Mechanical analyses of Dekalb silt loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
220801	1 mile northeast of Meadland.	Brown silt loam, 0 to 6 inches.	0.8	1.1	0.9	2.7	3.6	70.7	20.5
220802	Subsoil of 220801.	Silt loam to silty clay loam, 6 to 36 inches.	.0	1.0	1.0	2.0	3.7	66.7	25.7
220825	1 mile north of Morgantown.	Brown silt loam, 0 to 9 inches.	1.2	2.2	1.1	2.1	6.7	65.2	21.6
220826	Subsoil of 220825.	Silt loam to silty clay loam, 9 to 36 inches.	.5	1.6	1.0	1.7	5.5	60.6	28.8
220833	1½ miles southeast of Fairmont.	Brown silt loam, 0 to 8 inches.	.4	1.9	2.5	5.5	4.0	62.6	22.8
220834	Subsoil of 220833.	Silt loam to silty clay loam, 8 to 36 inches.	.8	1.0	1.5	3.6	4.6	56.3	32.1

DEKALB SILTY CLAY LOAM.

The surface soil of the Dekalb silty clay loam to a depth of 5 to 8 inches consists of a grayish-brown to yellowish-brown silty clay loam, the surface few inches being generally decidedly silty and in places, such as the lower slopes or on rather flat areas, a heavy silt loam. Some patches are considerably heavier than the typical soil, approaching the texture of a silty clay. The soil is usually rather friable and mellow and easily worked. In places both soil and subsoil are quite gritty. The subsoil is a yellow silty clay loam to silty clay, generally friable or brittle and in places becoming quite plastic. Occasionally the lower subsoil is somewhat mottled with various shades of gray and brown, such coloring being due often to the presence of partially decomposed shale fragments. Sometimes the subsoil has a slight reddish cast. Upon the surface and throughout the soil mass fragments of shale and sandstone, the former partially weathered, are frequently encountered, but not in quantities sufficient to interfere with cultivation. The more stony areas are confined to the steep slopes, where the sandstone ledges are not deeply covered with soil material, while on the smoother slopes, where the shales seem to have predominated, the harder rock is lacking or is represented only by narrow bands of sandy shale or shaly sandstone

fragments. A variation not common in this type occurs in central Taylor County and at a few places in Monongalia County, where bands of red soil are encountered on the hill slopes. While these are distinct, they are too small to map separately and have necessarily been included with the type. This phase approaches the condition of the Meigs clay loam, characterized by its patches of red soil, but in the latter there are usually a number of bands or streaks which have influenced the surrounding soils by intermingling with them.

The Dekalb silty clay loam is one of the most extensive soil types in the survey, occurring in all three counties. West of the Monongahela in Marion and Monongalia Counties it forms an irregular belt between the Meigs clay loam and the Westmoreland silty clay loam. It occupies the eastern half of Taylor County, and is well developed in eastern Marion and Monongalia Counties.

The topography is hilly, the soil occurring on the slopes and on the ridge and hilltops as well. (See Pl. I, figs. 1 and 2.) West of the Monongahela the Dekalb silty clay loam grades into the Meigs clay loam on the lower slopes of the hills, which are usually gentle and smooth. Generally to the east the formation rises, covering the whole slope and tops of the hills, and the type merges into the Westmoreland silty clay loam on the tops of the high ridges. In this belt the slopes are smooth and steep, although there are sections where the Dekalb silty clay loam covers both the tops and slopes of ridges, and the topography, though hilly, is not quite so broken and is better suited for cultivation. In the eastern parts of the area it covers the highest hills from base to summit. The slopes are generally steep, though the ridge tops are often rounded and quite broad. As would be expected from its hilly topography, the type has good surface drainage. The presence of stone throughout the soil mass in most cases further permits some downward movement of water. Seepy places are common on the slopes.

This soil is readily affected by drought, and crops suffer, but not to the extent that they do on the limestone lands.

The Dekalb silty clay loam is of residual origin and is derived from interbedded shales and sandstones. There are also some limestone beds, but these are thin and have very little effect, if any, upon the soils. The soil material comes from the Upper Monongahela, Lower Dunkard, Conemaugh, and Allegheny formations. The weathering of these rocks is not complete, as their fragments are found upon the surface and in the soil mass. Generally the depth of soil material exceeds 3 feet, but in places ledges approach the surface or outcrop.

This soil generally is friable and mellow and readily works into a good condition of tilth. The steep hillsides are difficult to cultivate and where worked are subject to damage by washing.

The greater part of the Dekalb silty clay loam is cleared and devoted to cultivated crops and to grass. Like all the uplands, the larger part is in grass, but as a whole it is not as strong grass land as the Meigs clay loam or Westmoreland silty clay loam. It does not seed naturally with bluegrass nor hold a bluegrass sod as do the two last-mentioned soils. Bluegrass persists for a while, but soon gives place to the native wild grasses. Broom sedge soon takes possession of most of the old fields.

Timothy and redtop are the principal grasses sown. They give moderate yields of hay. Clover is also sown to some extent, and where the soil is limed succeeds. Corn gives fair average yields and so do wheat and oats. Buckwheat does well on this soil, especially in the eastern section of the area, from 10 to 20 bushels per acre being secured. Irish potatoes do fairly well. Apples, while not grown on a commercial scale, are grown to some extent, and apparently give satisfactory results. Where the location is favorable, this soil should prove suited to commercial apple and peach orchards.

Commercial fertilizers are used on all crops on the Dekalb silty clay loam. The land is generally considered thin and the use of fertilizers necessary. The quantities used are small, and the fertilizer is generally of low grade. From 100 to 200 pounds to the acre are used. Barnyard manure gives better results than fertilizers. Quite a number of farmers apply lime and, as a rule, find it beneficial. The greatest need of this soil is the incorporation of organic matter to improve its moisture-holding capacity and to add humus and nitrogen. When barnyard manure can not be had green manuring crops should be turned under, preferably legumes, such as clover or cowpeas. Winter cover crops like rye and barley should be used when the land is cultivated, and plowed under in the spring to furnish organic matter.

The pastures should be reseeded often and treated with applications of fertilizers. Finely ground limestone and floats (phosphate rock) would help to improve the stand of grass even where the sod is not broken. The native forest growth consists mainly of oak and chestnut.

The value of the farms of this type of soil ranges from $10 to $50 an acre.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Dekalb silty clay loam:

Mechanical analyses of Dekalb silty clay loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
220805	2 miles northwest of Grafton.	Brown silty clay loam, 0 to 7 inches.	1.4	3.0	1.2	2.1	4.9	53.1	34.4
220806	Subsoil of 220805.	Yellow silty clay, 7 to 36 inches.	1.4	2.3	1.7	2.9	4.1	51.7	36.0
220809	One and one-half miles southeast of Opekiska.	Brown silty clay loam, 0 to 6 inches.	1.8	1.6	.9	2.2	4.4	58.0	31.1
220810	Subsoil of 220809.	Silty clay loam to silty clay, 6 to 36 inches.	1.8	3.2	2.0	3.7	5.1	56.1	28.6
220831	One-half mile west of Fairmount.	Brown silty clay loam, 0 to 8 inches.	2.8	5.8	4.6	6.1	8.3	50.8	21.5
220832	Subsoil of 220831.	Silty clay loam to silty clay, 8 to 36 inches.	1.8	2.5	1.8	3.1	7.6	47.8	35.4

DEKALB STONY LOAM.

The Dekalb stony loam, as typically developed, consists to a depth of 5 to 8 inches of a light or grayish-brown silty loam to silty clay loam, friable and mellow. The subsoil is a uniform yellow silt loam to silty clay, containing a sufficient content of sand to make it friable, and extending to a depth of 3 feet or more. Areas of light medium sandy loam too small to be shown on a map of the scale used in this survey are frequently found included in the type. The subsoil is occasionally tinged with red and in places the underlying sandstone bedrock closely approaches the surface.

Sandstone and shale fragments are found upon the surface and throughout the soil mass, usually in quantities sufficient to be conspicuous and to interfere more or less with cultivation. The soil itself is easily tilled, aside from the inconvenience resulting from these rock fragments. Physically the soil is typical of the established type, except that there are on the average not so many stone fragments as in most other areas.

The Dekalb stony loam is quite extensively developed in eastern Monongalia County, where it occurs in comparatively large but irregular-shaped areas. A few small tracts are found in eastern Marion and Taylor Counties. The type is principally developed on

slopes. In places it extends over the top of Chestnut Ridge. The slopes, as a rule, are long and smooth, and while rather steep are not so pronounced as the slopes of the hills of the other upland soil types. The tops where it occurs are broad and domelike. The type merges into the Rough stony land areas and to the south and west into the Dekalb silty clay loam. The small areas in Taylor and Marion Counties are found in the bowllike depressions where streams head, the development of these stony areas being due to the presence of the talus from sandstone ledges near the tops of the ridges.

The sloping surface of the type admits of ready surface drainage and the presence of stone in the soil mass allows free downward percolation of water, so that fairly good conditions of moisture are maintained at all times, and except in places where the soil is shallow it is not subject to drought.

The Dekalb stony loam is of residual origin and is derived from interbedded shales and sandstones belonging to the Lower Conemaugh and Allegheny formations. A number of sandstone strata occur in the formations contributing to the soil material and where these are present broken rock is found on the surface and throughout the soil mass. The Homewood sandstone of the Pottsville also enters to some extent into the formation of this soil type.

The greater part of the soil is cleared and under cultivation. Although it is not considered a strong soil, fair crops are generally assured in most seasons, as it is not affected so severely by extremes of moisture. The type averages somewhat higher as an agricultural soil in this area than in other sections of the State so far surveyed. Commercial fertilizers are used with the different crops, applications ranging from 100 to 200 pounds per acre. Corn yields from 15 to 50 bushels or more to the acre. The small grains make rather low yields. Buckwheat, however, does especially well and is grown on almost every farm. Yields of this grain range from 10 to 35 bushels an acre, with 15 to 20 hushels a fair average. Potatoes and garden vegetables also do well on this soil. Grass holds only fairly well and the hay yield is below the average. Timothy and redtop are sown with some clover and the pastures later run to native wild grasses, except bluegrass, which does not spread naturally on this soil. In favorable locations this soil should be well adapted to fruit growing. Apples, peaches, and plums would undoubtedly prove profitable.

The native tree growth is composed largely of oak and chestnut. The value of land composed of this type of soil ranges from $20 to $25 an acre, according to location and improvements.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Dekalb stony loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
220829	6 miles southeast of Morgantown.	Brown stony silty loam, 0 to 6 inches.	1.1	1.9	1.8	5.0	7.5	55.7	26.9
220830	Subsoil of 220829.	Silty clay loam, 6 to 30 inches.	.7	2.2	1.8	4.4	7.8	55.8	27.3

WESTMORELAND SILTY CLAY LOAM.

The Westmoreland silty clay loam consists of 4 to 10 inches of a grayish to light-brown silty clay loam, grading into a yellowish brown with depth. The surface few inches are decidedly silty. The subsoil consists of a yellowish to brownish-yellow silty clay loam, grading quickly into a silty clay, the latter being generally somewhat plastic. On the gentle lower slopes and more level situations the texture at times approaches a silt loam. The color of this soil is frequently a dark chocolate brown, though over the limestone strata from which this soil is in part derived the surface soil is a gray to yellowish heavy clay loam to clay, underlain by a stiff, plastic, yellow clay, occasionally mottled with gray or olive green. The depth generally exceeds 36 inches, except where the underlying rock approaches more closely to the surface.

The Westmoreland silty clay loam constitutes what is known locally as "limestone land," and is found in all three of the counties embraced in this survey. It is not derived from limestone exclusively, but rather from interbedded limestone and shales—some of which are calcareous—and some sandstone, the last-named being inconspicuous. The soil material derived from these rocks has intermingled in many places in such a way as to give rise to a fairly uniform soil type, although some patches of Dekalb silty clay loam and some spots of pure limestone soil have been included. Weathering has been complete, and, except on the tops of hills and ridges, the areas are for the most part free of rock fragments.

These pure limestone soil areas are confined to small spots on slopes over limestone ledges, or where the limestone strata are present near the surface. Had they been more extensive, they would have been separated and mapped as a separate type, Brooke clay loam, locally known as "ridge limestone land."

The rocks giving the Westmoreland silty clay loam belong to the Monongahela and Conemaugh formations. The upper limit in the

Monongahela is the Uniontown limestone, which is about 270 feet above the Pittsburgh coal. Between the limestone and the coal are several important limestone formations. Below the Pittsburgh coal the limestones, as a rule, are not so prominent, but occur in several beds, mostly thin and unimportant. The lower limit is usually the Clarksburg limestone, 165 feet below the Pittsburgh coal, but in places the limestone soil extended to the Buffalo sandstone in the lower Conemaugh. East of the Monongahela in Marion and Monongalia the limestones were not persistent, being supplanted by sandstones, so that in places no limestone soils were found associated below or immediately above the Pittsburgh coal.

The Westmoreland silty clay loam is found throughout the area. In Marion and Monongalia Counties it follows the course of the Monongahela River and in Taylor County it occurs in the western part along the Harrison County line, broadening out to the south along the Barbour County border. Like the other main upland soil types, it occupies hilly topography, although usually somewhat smoother than the average. (See Pl. I, figs. 1 and 2.) The hill or ridge tops are generally rounded, with long, smooth slopes. Occasionally the slopes are broken by benches formed by the more resistant beds of limestones. Such spots are marked by the stronger growth and by the bright green color of the grass. The surface configuration provides ready surface drainage. The type suffers from erosion, gullies being found where care is not taken to check the rapid run-off of storm waters. Small, bare, eroded spots on the hill slopes are very common.

The calcareous nature of the Westmoreland silty clay loam makes it an especially desirable soil for bluegrass, consequently it is more profitable for grazing purposes than for the production of cultivated crops. Bluegrass takes possession of the land naturally and the sod is practically permanent. From 3 to 5 acres is enough to support a 3-year old steer. Whenever the fields are cultivated and are returned to grass timothy, redtop, and clover are sown. Sometimes orchard grass is substituted. These are cut for hay for a number of seasons and in the meantime the bluegrass comes in and finally the field is turned over to permanent pasture. The yield of hay is the highest secured on any of the upland soils. Orchard grass does well, especially on the lower slopes or where moist conditions prevail. Very little of this soil is devoted to cultivated crops, but such areas give good yields. Corn ranges from 35 to 75 bushels to the acre and the small grains yield correspondingly well. The crops are grown without fertilizers, though some farmers are beginning to make small applications. Lime is used by some and is always followed bv beneficial results.

Practically all the land of this type is cleared. The original growth consisted of the deciduous hardwoods. The locust is partial to this soil and is seen in small groves on the hillsides and along the fence rows. The growing of this tree for fence posts would no doubt prove a profitable venture. Farms on this soil have a generally prosperous appearance, the houses and outbuildings being large and in good repair. Large barns are quite common, which is not the rule for the area as a whole.

The land, aside from the valuable coal beds underlying most of it, has a high value. It is not on the market, but is held at prices ranging from $50 to $100 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Westmoreland silty clay loam:

Mechanical analyses of Westmoreland silty clay loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
220807	1¾ miles north of Simpson.	Silty clay loam, 0 to 7 inches.	1.0	1.8	1.3	3.1	3.4	43.2	46.2
220808	Subsoil of 220807.	Yellow silty clay, 7 to 36 inches.	.4	.9	1.1	2.2	1.0	41.0	53.3
220811	5 miles south of Fairmont.	Silty clay loam, 0 to 7 inches.	1.3	1.3	1.0	1.9	3.7	59.7	31.0
220812	Subsoil of 220811.	Yellow silty clay, 7 to 36 inches.	.8	1.8	1.4	3.0	2.9	47.4	42.9
220821	1 mile north of Vanvoorhis.	Silty clay loam, 0 to 8 inches.	.8	1.2	.8	1.5	3.7	65.6	26.4
220822	Subsoil of 220821.	Silty clay loam to silty clay, 8 to 36 inches.	.4	1.2	.9	1.5	4.9	60.6	30.3

ROUGH STONY LAND.

Rough stony land includes areas too steep and stony to cultivate and naturally unsuited to agriculture. It is limited to the steep hillsides and mountainous areas. The type owes its existence to massive beds of sandstone which outcrop usually near the tops of hillsides, forming precipitous cliffs below which the talus gives rise to exceedingly stony slopes, broken by large bowlders, and unsuited to cultivation. These occurrences are found along the streams and are indicated on the map by appropriate symbols. In northeastern Monongalia County Rough stony land is frequently found on the broad, smooth tops of the ridges, together with rock outcrops, remains of former rock beds and large angular bowlders, some of them the size of a small house.

Areas of Rough stony land are scattered throughout the three counties, but occur more frequently and in larger areas in the eastern sections, where the sandstone formations are more in evidence. The smaller areas are found along abrupt slopes to streams and the larger along the Monongalia and Preston County line. The Cheat River and Deckers Creek gorges are so steep and stony that they are almost impassable. The type is found in all of the geological formations outcropping in the county, including the Upper and Lower Carboniferous. The Allegheny and Pottsville series are most prominent in its formation, as they are largely composed of massive strata of sandstone. The Pottsville forms the top and upper slopes of the mountainous ridge in northeast Monongalia, while the strata below are found in the Cheat River and Deckers Creek gorges.

The term Rough stony land as used in the soil classification denotes a condition rather than a soil type. Except upon the bare rock outcroppings, some soil is found between the stones and bowlders and is of variable texture, but similar to that occurring on the same slope where agriculture can be carried on.

Rough stony land areas support a growth of oak, chestnut, and various other trees and shrubs. In the gorges and steep ravines in the eastern part of the area the mountain laurel and hemlock are characteristic of the type. This class of land should be allowed to remain forested. Cleared areas, which are few, are used as permanent pastures. Aside from its forest growth and its slight value as pasture, the Rough stony land is practically worthless.

ELK SILT LOAM.

The Elk silt loam consists of 6 to 10 inches of light-brown to yellowish-brown silt loam, generally friable and mellow, underlain ordinarily by a yellow, friable silt loam to silty clay loam, becoming more sandy at depths ranging from 24 to 30 inches. In some situations, such as next to upland slopes, where the material may be in part residual or alluvial, the subsoil is somewhat heavier, changing from a silty clay loam to silty clay of a slightly plastic structure. The material as a rule is friable, but becomes quite sticky when wet. Another variation is found near Fairmont, where the soil is slightly sandy in small spots and underlain by beds of bright yellow to reddish-yellow sand. These deposits have been opened and the sand used for building purposes.

The type is generally free from stone and gravel, though occasionally where shale ledges come near the surface there are some fragments of this rock in the soil mass. In other places also, as shown by exposures on sides of ravines, the soil mantle overlies either sandstone or limestone beds, but these are usually more than

3 feet beneath the surface. As a whole the depth of the soil formation is several feet.

The Elk silt loam is the most extensive of the transported soils. It is confined principally to the Monongahela River Valley, although some areas are found along the tributary streams near their confluence with the Monongahela. The largest areas are in the bends of the river and in the vicinity of Fairmont, where the Tygart and West Fork Rivers come together. The areas are not continuous, occurring on each side of the stream as the channel meanders from side to side.

The Elk silt loam is a stream terrace soil. Although the surface was originally flat, much of the type has been dissected in varying degrees by erosion, some areas being now gently rolling. The terraces drop off to the first bottoms, either through slopes or by sharp bluffs. The elevation of the terraces above the stream channels ranges from 40 to 150 feet.

The Elk silt loam is derived from old alluvium deposited when the water of the streams reached higher levels.

The type is probably composed of material derived from all the soils of the drainage basin, including considerable limestone soil. It differs in this from the Holston silt loam, which has its origin mainly from wash from shale and sandstone soils. In places some of the lower subsoil may be residual from the underlying rocks. Near the upland slopes the soil has been influenced to some extent by colluvial material from the adjacent slopes.

Lying as it does, on terraces well above the river, the drainage is well established. The structure is friable and mellow, and the soil, therefore, easy to cultivate. Its proximity to a large stream and the favorable surface configuration caused it to be one of the first to be brought under cultivation. It is practically all occupied at the present time, all the crops of the region being produced upon it, though, as with most soils of this area, a large part is in grass for hay or pasturage. Bluegrass occurs to some extent upon it, but timothy, redtop, and clover are the crops cut for hay, with occasionally some orchard grass. The yield of hay is fair, and the pastures are fairly durable. The small grains, and especially wheat, do well on this soil. Corn is the most important of the cultivated crops, giving fair to good yields. Although only small patches of potatoes are grown, the yields are excellent, and the acreage could profitably be increased. Very little trucking is done in the area. This soil is better than any of the other types for this purpose. It would be adapted to a wide range of vegetable crops, and could support an extensive trucking industry. It would also prove suitable for small fruits, strawberries, and other berries.

This soil responds readily to any good system of management. Its greatest need is the incorporation of organic matter, in which it is

now deficient. Barnyard manure is the best for this purpose, but lacking this, the legumes, such as clover, cowpeas, soy beans, and vetches, plowed under, are very satisfactory.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Elk silt loam:

Mechanical analyses of Elk silt loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
220819	2 miles north of Morgantown.	Brown silt loam, 0 to 8 inches.	0.4	0.9	1.0	2.1	5.4	72.8	17.3
220820	Subsoil of 220819.	Yellow silt loam, 8 to 36 inches.	.0	.3	.4	1.0	3.4	68.5	26.2
220835	1 mile southwest of Fairmont.	Brown silt loam, 0 to 8 inches.	.7	2.0	1.7	3.3	9.7	63.9	18.6
220836	Subsoil of 220835.	Silt loam to silty clay loam, 8 to 36 inches.	1.1	2.2	2.0	4.2	9.1	62.0	19.2

HOLSTON SILT LOAM.

The surface soil of the Holston silt loam to a depth of 6 to 10 inches consists of a light to yellowish-brown, friable silt loam. This is underlain by yellow silt loam, usually changing to light silty clay loam, and frequently to silty clay, although in places the subsoil continues downward as a friable silt loam, becoming a little lighter textured or sandy in the lower portions and somewhat compact at depths below 24 inches. In the lower-lying, poorly-drained areas some mottling of gray is found in the subsoil, such areas approaching the characteristics of the Tyler silt loam. The areas along Cheat and Tygart Rivers carry more sand particles, and in places approach a sandy loam texture.

The Holston silt loam is generally free of stone or gravel, except in the areas along Cheat River, where small, rounded gravel and sandstone cobbles are found in the soil mass and on the surface. Small deposits of sand are also encountered.

The type is most extensively developed along Dunkard Creek, in the northern part of Monongalia County, along the Cheat and Tygart Rivers, in Marion and Taylor Counties, and in small areas along the larger creeks. It is found as terraces varying in altitude from 40 to 150 feet above the present levels of the streams. These originally flat terraces have been dissected somewhat by erosion, and are now more or less gently rolling. Only in a few places has the original flat surface been preserved.

The type owes its origin to water-deposited materials laid down when the streams flowed at higher levels than now. The material was deposited in the same way as that of the Elk silt loam, which type it resembles very closely. It differs from the Elk in that it was washed from regions containing very little limestone soil, being largely derived from shale and sandstone soils.

The Holston silt loam is a type of moderate productivity. It is a well-drained soil, and produces the general crop of this region. It is easily worked, responds readily to good treatment, and is all cleared and devoted to farm crops, a good part of it being in grass for either hay or pasturage. It gives fair yields, especially of corn and potatoes, but is not a strong grass land. It could be advantageously used for small fruits and truck crops.

The greatest need of the type is organic matter. This may be supplied either as stable manure or by turning under green manuring crops. The value of farming lands of this type is high.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Holston silt loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
220813	6 miles south of Fairmont.	Brown silt loam, 0 to 8 inches.	0.3	1.9	3.4	10.1	8.4	57.4	18.5
220814	Subsoil of 220813.	Silt loam to silty clay loam, 8 to 36 inches.	.0	1.3	2.6	10.0	11.1	51.9	22.6
220817	1½ miles northeast of Mooresville.	Brown silt loam, 0 to 8 inches.	.5	.9	.7	4.5	6.1	67.1	20.0
220818	Subsoil of 220817.	Yellow silt loam, 8 to 36 inches.	.3	1.0	.9	6.1	8.2	62.9	20.5

TYLER SILT LOAM.

The Tyler silt loam consists of 8 inches gray to grayish-brown, slightly friable silt loam, underlain to a depth of 24 inches by a pale-yellow to yellow silty clay loam, grading into a silty clay in the lower portion. At 18 to 20 inches mottlings of gray, yellow, drab, and brown appear, the gray becoming more pronounced with depth. The type is free from stone and gravel.

There are only a few small areas of the Tyler silt loam in the area. These occur on Dunkard Creek and to a less extent along several other streams. All the type mapped is found in western Monon-

galia County, although areas too small to map are encountered in other sections. The type occupies flat to gently sloping terraces along streams and is closely associated with the Holston silt loam. It is derived from the same material as the Holston silt loam, the difference being the result of poor drainage. The average elevation of the type above the stream courses is 40 feet. Its close, compact subsoil is more or less impervious and the areas are generally wet and cold.

Owing to its poorly drained condition the type is best adapted to grass. When drained it gives good crops of the small grains. In moderately dry seasons corn does fairly well, but in wet seasons the crops drown, the impervious subsoil holding the water on the surface.

The extent of this soil is so small that it is of very little importance in this area. With drainage and careful management it can be made a productive type.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Tyler silt loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
220803	3 miles north of Core.	Brown silt loam, 0 to 8 inches.	0.2	0.9	1.6	9.3	7.6	60.6	19.7
220804	Subsoil of 220803.	Silty clay loam to silty clay, 8 to 36 inches.	.0	.3	1.1	7.1	6.4	47.1	37.9

HUNTINGTON SILT LOAM.

The surface soil of the Huntington silt loam, to an average depth of 10 inches, consists of a brown to chocolate-brown, friable silt loam to silty clay loam. The subsoil is usually lighter colored than the surface soil, owing to a lower organic matter content. It ranges from a light-brown to yellowish-brown or dark-yellow silt loam to silty clay loam, becoming slightly compact at depths below 24 inches and from 24 to 30 inches approaching somewhat a sandy loam in texture. Occasionally a gravelly substratum may be encountered within 36 inches of the surface.

In the eastern part of the area, where the sandstones occur in abundance, the texture in places is a medium to fine sandy loam on the surface, and this material is underlain by sandy loam to a depth greater than 36 inches. Usually, however, there is a silty mantle of varying depth overlying the sandy material. These areas frequently

carry some gravel. Along the immediate banks of the streams the material is decidedly sandy. The sandy phases of the type are small and disconnected and but for their small size would have been recognized as a sandy type in the Huntington series. In the main the type is free of gravel or stone fragments on the surface, the exception being near the steep upland slopes where streams break through. The gravel is mostly shale and small pieces of shaly sandstone, with rounded or subangular edges.

The Huntington silt loam is widely distributed outside the territory occupied by the Moshannon silt loam. It occurs as narrow strips in the stream valleys; and while the areas are fairly numerous, the total extent is small. It is found occupying first bottoms along the streams, usually narrow and flat, or gently sloping to the upland levels. As mapped it occurs from barely above the stream level on the smaller branches and runs to as high as the 20-foot contour line along the larger creeks and rivers.

This type is of alluvial origin and is still in process of formation. The material is composed of sediments washed from the upland soils and deposited by the streams on their flood plains in times of high water. The material comes from many different geological formations, including sandstone, shale, and limestone. The type has been considerably influenced by wash from the Westmoreland silty clay loam, the limestone soil of the area. The type is a fairly well drained soil, though in places small areas could be improved by open ditches. It ranks as a strong, productive soil.

This type is all cleared and under cultivation. A large part of it is in grass. Good yields of hay are secured and, the moisture conditions being favorable, the growth of grass is excellent throughout the grazing season. Timothy and clover are the main hay crops. Orchard grass is also sown to some extent and makes a rank, heavy growth, being naturally adapted to a moist soil.

As in most bottom-land types, the small grains make a vigorous growth, but are subject to damage by freshets and have a tendency to lodge.

Corn is the leading cultivated crop on the type. It is particularly well adapted to this crop, and gives yields as high as 100 bushels or more per acre. Corn often receives all the manure made on the farms, as where it occurs the Huntington silt loam is relied upon to produce most of the corn for the farm needs.

In the eastern part of the area, where the sandy subsoil lying close to sandstone is encountered, this type is not considered so good, although it produces fair yields. The higher, well-drained parts produce fair crops of potatoes of good quality.

As most farms are cut by stream valleys, they usually include some bottom land, and the Huntington silt loam is therefore a considerable

factor in determining farm values. As the bottom lands are not sold separately, their value can not be stated, although they increase the value of farm holdings according to their extent on individual farms.

The original forest growth consisted of sugar maple, oak, poplar, sycamore, walnut, and butternut.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Huntington silt loam:

Mechanical analyses of Huntington silt loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
220815	2 miles northwest of Laurel Point.	Brown silt loam, 0 to 12 inches.	0.4	1.0	1.1	4.4	7.9	54.7	30.5
220816	Subsoil of 220815.	Brown silt loam, 12 to 36 inches.	.3	1.3	1.6	9.0	10.9	51.0	25.9
220827	One-half mile northwest of Boothsville.	Brown silt loam, 0 to 10 inches.	.1	.6	1.8	14.0	17.5	39.8	26.0
220828	Subsoil of 220827.	Silt loam, 10 to 36 inches.	.0	.5	1.9	15.0	13.5	44.9	23.7

MOSHANNON SILT LOAM.

The surface soil of the Moshannon silt loam, to an average depth of 10 inches, consists of a dark-brown or dull reddish brown, mellow silt loam to silty clay loam. The subsoil is similar in texture to the soil, but is slightly compact, and at 24 to 30 inches usually becomes somewhat sandy. In color it is a yellowish brown, with a tinge of red. Typical areas of this soil found in the counties west of the area have an Indian-red to reddish-brown soil.

A variation from the type is noticed in the presence of a gravelly substratum occurring either within the soil profile or below it.

At the point of confluence of the small streams with the rivers alluvial fans are formed which in many instances contain considerable quantities of small shale and sandstone fragments; otherwise the type is free of gravel on the surface and in the upper part of the soil section.

The Moshannon silt loam is found in the western part of Marion and Monongalia Counties, occurring in all the stream valleys. The total extent of the type, however, is small. It forms the first bottoms of the creeks and runs and is subject to annual overflow at times of high water. It is associated with the Meigs clay loam, the residual upland soil derived from the different rock strata of the Dunkard formation. It represents wash or sediments carried down the slopes

by the rains and taken up and deposited lower down the stream courses during flood stages. Next the upland slopes the soil material no doubt largely represents accumulations from the adjacent slopes.

The type is an alluvial soil of recent origin. The Meigs clay loam, which, as previously stated, is derived from the Dunkard formation, is characterized by the presence of bands of Indian-red soil on the slopes, where it joins with other soils formed from the gray shales and sandstones. The wash from these red soils has imparted a reddish tinge to the bottom land soils of that particular section and distinguishes them from the Huntington silt loam, which, on account of its different origin, is of a chocolate-brown color.

The streams along which this type occurs are still cutting their channels and no extensive first bottoms occur. Small first bottoms, however, are always present, varying in width from a rod or two on the smaller streams to not over one-eighth of a mile on the larger ones. These bottoms are flat or rise gradually to the upland slopes. On the runs they lie 2 or 3 feet above the stream levels, but along the larger streams their elevation is ordinarily from 5 to 10 feet, and never exceeds 20 feet.

The position occupied by the Moshannon slit loam enables it to maintain a good supply of moisture at all times, though it is not wet or poorly drained, except over small local areas forming troughs. In places open ditches are dug to assist drainage.

Like the Huntington silt loam, the type is a strong, productive soil. It is excellent for grass, giving large yields of timothy and clover hay. Orchard grass, because of the good supply of moisture, also makes a heavy growth. This grass is planted to some extent and furnishes excellent pasturage, the growth continuing throughout the summer season, while the grass on the uplands is suffering for want of sufficient moisture. A large part of the type is used for mowing land.

Small grain crops make a rank growth and good yield, but lodge. Corn is the leading cultivated crop. In fact, the bottom lands are depended upon to produce all the corn needed on most farms. The yield ranges from 35 to 100 bushels to the acre. Stable manure is generally applied to this land. Some farmers also use small quantities of commercial fertilizers with the corn, especially when the bottoms have been worked for some time or lie above the ordinary level of overflow. Where flooded, fresh additions of rich sediments are annually deposited.

The value of the bottom lands composed of the Moshannon silt loam is high and largely determines the value of farms where they occur.

Sugar maple, poplar, sycamore, walnut, and butternut formed the larger part of the original forest growths.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Moshannon silt loam:

Mechanical analyses of Moshannon silt loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
220823	3 miles west of Mannington.	Brown silt loam, 0 to 8 inches.	0.2	0.5	0.8	11.0	17.2	45.8	24.7
220824	Subsoil of 220823.	Silt loam, 8 to 36 inches.	.0	.0	1.0	14.6	16.4	45.2	22.7

SUMMARY.

The Morgantown area includes the counties of Marion, Taylor, and Monongalia, situated in the north-central part of the State of West Virginia. It has an area of 560,000 acres, or 875 square miles.

The area consists of an elevated region cut by stream valleys eroded to depths ranging from 300 to 600 feet below the general upland level. The topography is hilly and broken. The altitude ranges from 800 to 2,683 feet above sea level.

The Monongahela River and its tributaries drain the area, the waters flowing north and ultimately finding their way into the Ohio River.

The area is populated by descendants of the early settlers of Scotch-Irish stock and the foreign labor working in the mines. The census of 1910 gives the three counties included in this area a population of 83,682.

The climate is suited to general farming. The mean annual temperature is 53° F. and the mean annual precipitation 41 inches, usually well distributed throughout the year.

Agriculture is in the main confined to the production of the general farm crops and stock raising. Corn, wheat, oats, buckwheat, and potatoes are the principal crops and a relatively large acreage is annually mowed for hay.

The development of the oil and gas resources has taken the labor from the farms by offering higher wages. The income from the rentals and royalties generally exceeds that from the farm, and these, together with the sale of the workable beds of coal, have put most owners in good financial condition.

There are many opportunities for successful agriculture in the region. Stock raising could well be extended by improving the pastures through more frequent reseeding and by using commercial fertilizers. In this way the grazing capacity could be greatly in-

creased. The rougher lands, especially in the western part of the area where sheep do so well, should be devoted to grazing.

Fruit growing, particularly apples, would prove profitable under good management. There are good orchard sites on most farms.

The demands of the local markets warrant the development of the trucking industry. The high terrace soils are well suited to a wide range of trucking crops. There is also opportunity for increased production of dairy products, the demand for them showing a steady growth.

There is much land that should be used for forestry, particularly the steeper slopes, where timber for fence posts could be grown profitably.

Ten soil types, exclusive of Rough stony land, were separated and mapped in the area. These are divided into two classes, according to origin; (1) residual soils, and (2) alluvial soils. The former occupy the uplands and are derived from a variety of shales, sandstones, and limestones of Carboniferous age; the latter have been deposited as stream sediments in the valleys.

The Meigs clay loam is one of the extensive upland soils found in the western and central parts of the area. It is derived from the Dunkard formation of the Upper Carboniferous. It has a steep, broken topography and is used largely for pasturage. It is a good grass soil.

The Westmoreland silty clay loam is the "limestone land" of the region. It is especially valued for its bluegrass pastures and is used almost entirely for grazing cattle.

The Dekalb silty clay loam is an extensive soil type found in the eastern and central parts of the area. It is not a strong grass soil, though used for grazing. It is devoted to the general farm crops.

The Dekalb silt loam occupies the flat tops of hills overlying beds of massive sandstone. It is an easily cultivated soil, but is not strong. Potatoes and buckwheat succeed well upon it.

The Dekalb stony loam is found mostly on the mountain ridges in eastern Monongalia County, occurring on the long, smooth slopes. It produces fine crops of corn, buckwheat, and potatoes.

Rough stony land comprises the cliffs of massive sandstone found on the hillsides, together with talus slopes below. It has no value except for forestry and a little grazing.

The valley or alluvial soils occupy the terraces and bottoms along the streams. The most important type is the Elk silt loam, found along the Monongahela and its tributaries. This type is derived in part from wash from limestone soil. Though it is not a strong grass soil, it is easily improved and has a wide crop adaptation. This soil is fairly well located for the production of truck crops to supply the local markets and the mines.

The Holston silt loam occupies the same topographic position as the Elk silt loam, but is not as strong a soil, not being influenced to so great an extent by calcareous soil material.

The Tyler silt loam is of small extent, found usually on second terraces, and is poorly drained. It is a good grass soil.

The first bottoms comprise two types, the Moshannon silt loam and the Huntington silt loam. The former is found in the western part of the area and is of reddish color, being influenced by wash from the red shale soil levels occurring in the Meigs clay loam. The latter is the brownish colored soil found elsewhere in the area, and is also influenced to some extent by wash from the limestone land areas. Both these soils are strong and productive and are important factors in the agriculture. Though the areas occupied by them are small, they are widely distributed and occur on practically every farm.

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[PUBLIC RESOLUTION.—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the Congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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SOIL MAP
WEST VIRGINIA
MORGANTOWN SHEET

WEST VIRGINIA GEOLOGICAL SURVEY
I. C. WHITE, STATE GEOLOGIST

U. S. DEPT OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY CHIEF
CHARTS PUBLISHED IN COOPERATION WITH WEST VIRGINIA GEOLOGICAL SURVEY

Hugh H. Bennett, Inspector in charge Southern Division
Soils surveyed by Charles N. Mooney and W. J. Latimer

BASE MAP FROM U. S. GEOLOGICAL SURVEY SHEETS

Scale, approx.
1 0 1 2 3 4 5 Miles
Contour Interval 20 and 50 Feet.
Datum is mean sea level.

Land Operations
Bureau of Soils
1911

LEGEND

Dsl Dekalb stony loam
Ds Dekalb silt loam
Dc Dekalb silty clay loam
M Meigs clay loam
W Westmoreland silty clay loam
El Elk silt loam
Hs Holston silt loam
T Tyler silt loam
Hl Huntington silt loam
Ml Melvindale silt loam
R Rough stony land

Dsl Dekalb stony loam
Ds Dekalb silt loam
Dc Dekalb silty clay loam
M Meigs clay loam
W Westmoreland silty clay loam
El Elk silt loam
Hs Holston silt loam
T Tyler silt loam
Hl Huntington silt loam
Ml Melvindale silt loam
R Rough stony land

SOIL PROFILE
(3 feet deep)

Dsl Dekalb stony loam
Ds Dekalb silt loam
Dc Dekalb silty clay loam
M Meigs clay loam
W Westmoreland silty clay loam
El Elk silt loam
Hs Holston silt loam
T Tyler silt loam
Hl Huntington silt loam
Ml Melvindale silt loam

LEGEND

Sld Silty clay loam
Sld Silty clay
Sld Silt loam